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sciences

Petrographical and geochemical signatures of the Granja paragneisses (NW Ceará, Brasil)

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Abstract

The Granja Granulitic Complex (GCC) constitutes a NE–SW trending high-grade metamorphic belt occupying the western sector of the Médio Coreaú Domain (NW Ceará, Brasil) (Figs. 1 and 2). According to the published data, the GCC represents a segment of the Paleoproterozoic basement intensely reworked during the Brasiliano Orogeny. Lithologically, the GCC is mainly composed of garnet-sillimanite migmatitic paragneisses, enclosing discontinuous lenses of mafic granulites and enderbites.

At outcrop scale, the GCC gneisses are well-foliated fine- to medium-grained grey rocks showing a stromatic layering parallel to the main regional fabric (Fig. 3). The occurrence of lenses of leucocratic quartz-feldspathic material interlayered with the host paragneisses indicates that these rocks reached partial melting conditions during the Brasiliano orogenic event (≈ 600 Ma).

Petrographically, the gneisses are characterized by the presence of mineral assemblages dominated by garnet, sillimanite and biotite with moderate amounts of quartz, plagioclase, cordierite and K-feldspar (Figs. 4a-b).

Twelve whole-rock samples were analyzed for major and trace elements. As shown in Graph 1, all the analyzed samples plot in the sedimentary field. Their REE patterns closely resemble those of PAAS (Post-Archean average Australian Shale) confirming the sedimentary origin of the paragneiss protoliths (Graph 2). Geochemical data also suggest that these sediments derived from source areas of felsic to intermediate composition and were deposited in a tectonically active continental margin (Graphs 3 and 4).

Geological Setting

The Médio Coreaú Domain

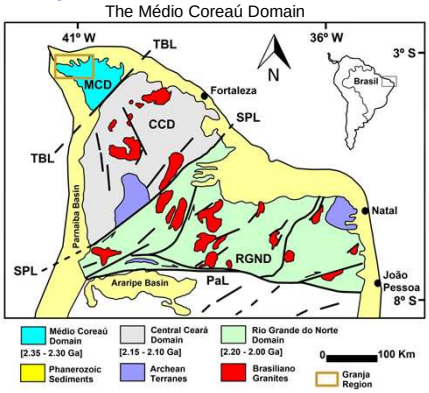


Fig 1 / Geological map for the northern part of the Borborema Province, showing the location of the Médio Coreaú Domain. TBL -Transbrasiliano Lineament; SPL; Senador Pompeu Lineament; PaL - Patos Lineament.

Field Occurrence

The Granja paragneisses

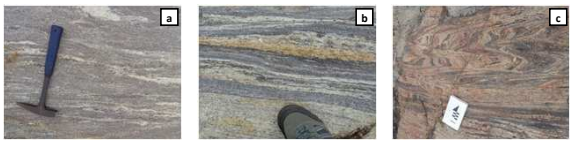
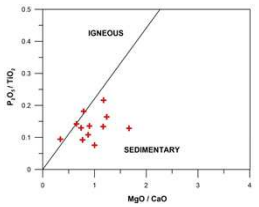
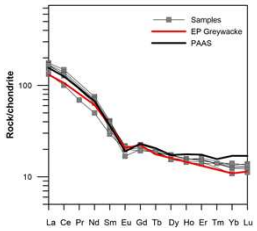


Fig 3 / Field appearance of the Granja paragneisses: (a) gneissic banding and thin stromatic layering in paragneiss; (b) Garnet bearing leucossomes interleaved with the host gneisses; (c) Folded lenses of meta-igneous granulites enclosed in the paragneisses.

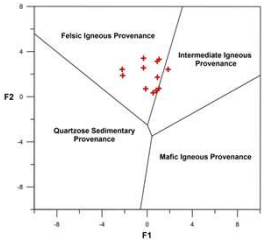
Geochemistry



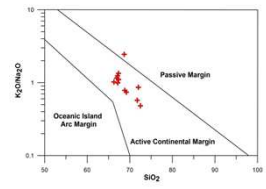
Graph 1 / P_2O_5/TiO_2 versus MgO/CaO discrimination diagram (Werner, 1987) for the analysed Granja paragneisses.



Graph 2 / Chondrite normalized REE patterns for the Granja paragneisses (grey squares). Black line represents post-Archean average Australian shale (PAAS) and red line Early Proterozoic average Greywacke.



Graph 3 / Classification of the analysed samples according to the provenance discrimination diagram proposed by Roser and Korsch (1988).



Graph 4 / K_2O/Na_2O versus SiO_2 tectonic setting discrimination diagram of Roser and Korsch (1986).

The Granja Complex

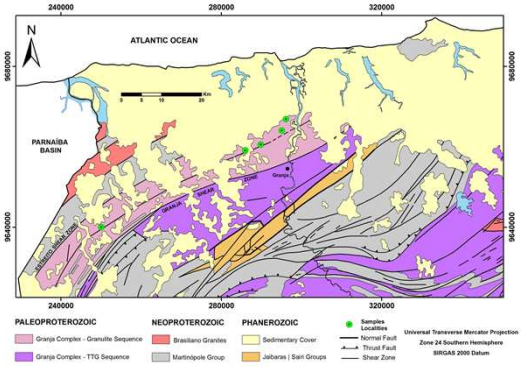


Fig 2 / Simplified geological map for the Granja region, showing the location of the analysed samples.

Petrography

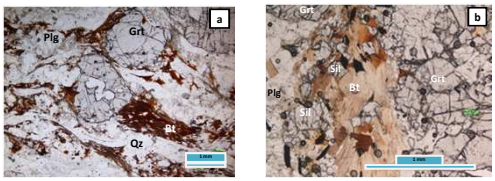


Fig 4 / (a) High-grade metamorphic paragenesis in Granja paragneiss with a mylonitic fabric; (b) Prismatic sillimanite associated with biotite and garnet poikiloblasts | [garnet (Grt), sillimanite (Sil), biotite (Bt), quartz (Qz), plagioclase (Plg); plane polarized light]

Conclusions

- The garnet–sillimanite migmatitic paragneisses exposed in the MCD experienced intense deformation and granulite facies metamorphism during the Brasiliano Orogeny.
- Microstructures and mineral assemblages reveal a metamorphic history involving four main stages: a prograde metamorphic stage (M1), a peak-metamorphic stage (M2), a post-peak decompression stage (M3) and a retrograde cooling stage (M4). Partial melting conditions were reached during M2 and persisted after the metamorphic peak (M3).
- Overall, the whole-rock geochemical data suggest that the sedimentary protoliths of the Granja paragneisses had mixed greywacke-shale compositions and could have resulted from erosion of intermediate to felsic igneous rocks. Sediment deposition would have occurred at an active continental marginal / continental island arc setting.

References

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